Developmental Biology of *Anua indiscriminata* in the Laboratory (Lepidoptera: Noctuidae)

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ABSTRACT

Anua indiscriminata, a guava pest in Hawaii, was studied under laboratory conditions. The egg stage lasted 5.72 ±0.51 days; lst, 2nd, 3rd, 4th, 5th and 6th larval stadia were 5.14 ±0.64, 3.61 ±0.70, 4.12 ±0.57, 4.54 ±0.68, 4.47 ±0.68, and 10.27 ±0.84 days, respectively. Prepupal and pupal periods were 4.39 ±0.49 and 24.91 ±1.22 days, respectively. The prepositional period was 13.94 ±3.05 days, while the adult longevity was 29.62 ±7.27 days for males and 30.30 ±8.99 days for females.

INTRODUCTION

The guava moth, *Anua indiscriminata* (Hampson), is found in Assam, Ceylon, the Philippines (Hampson 1913), and was first reported on Oahu Island in 1974 at Hickam Air Force Base, Manoa, Nuuanu, and Kaneohe (Mau 1976). Nakahara (1978) reported that *A. indiscriminata* is now on all major Hawaiian islands except for Molokai. *A. indiscriminata* larvae have been recorded feeding on guava, *Psidium guajava* L. and purple strawberry guava, *P. cattleianum* Sabine, in Hawaii (Mau and Shiroma 1976). Hampson (1913) listed *Eucalyptus*, *Carea*, and other Myrtaceae as host plants. In Hawaii the guava moth is a minor pest of guava trees, but it can become a major defoliator. This study was undertaken to determine the biology of *A. indiscriminata* since a search of the literature revealed no biological studies of this moth.

MATERIALS AND METHODS

The biology of *A. indiscriminata* was studied in Hilo, Hawaii from February to June 1979. Rearing was conducted in an air-conditioned laboratory having a mean temperature of 23.1°C, a mean high of 23.9°C and a mean low of 22.3°C. The mean relative humidity was 67.1%, a mean high of 84.0% and a mean low of 54.0%. Eggs were obtained from field-collected adults since our preliminary studies indicated that lab reared adults produced sterile eggs. Adults were reared in reclined wide mouth 3.78 liter jars lined below with paper towel, and the opening was covered with nylon organdy secured with a rubber band. Absorbent cotton soaked with honey-water (1:1) solution was placed in a petri dish bottom (100 x 10 mm) and placed in the adult rearing jars. Eggs deposited on the paper towel were collected daily and held in separate batches for hatching.

Eggs were incubated in glass petri dishes (100 x 10mm) containing 2 moist filter paper circles (9cm diam). Emerging larvae were transferred daily at a specific time and placed individually in 0.22 liter paper containers (#1812S Lily ® Nestrite ®) covered with a perforated plastic lid. Each larva

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was fed guava shoot terminals bearing ca. 3 leaves. The base of each shoot was wrapped with wet absorbent cotton and inserted in 1 dr shell vials containing tap water. Bouquets were replaced daily. Larvae were observed daily at a specific time and each larval instar was determined from the number of molts.

Molted head capsules of all instars were measured except for the 6th instar. The head capsule of the prepupa (6th instar) split along the coronal suture when transforming into the pupa. This resulted in an inaccurate head capsule measurement. Therefore head capsule widths of 6th instar larvae were measured on each larva. Measurements were made with a Wild M7A zoom stereo-microscope equipped with occular micrometer.

Emerging adults were grouped in 3 and placed in rearing jars and provided with honey-water as mentioned earlier. Adults were observed daily at a specific time to detrmine the preovipositional period and adult longevity.

Results and Discussions

EGG

Eggs are spherical with vertical ridges equally spaced on the chorion. The egg is flat ventrally to form an adhesive disk. Freshly laid eggs were greenish-gray becoming dark brown before hatching and had a mean diameter of 1.15 (0.03 SD) mm (n = 245). Eggs were deposited singly or in small clusters ranging from 2-10 eggs. The mean incubation period was 5.72 (0.51 SD) days (n = 426) (Table 1).

LARVAE

Hampson (1913) briefly described the color pattern on *A. indiscriminata* larvae but made no reference to the number of larval instars. In this study molted head capsules were measured and the frequency distribution are presented in figure 1. The distribution fell into 6 distinct groups representing each larval instar. Table 1 presents the duration of each larval instar, and Table 2 summarizes the mean head capsule widths.

The 1st instar larvae were differentiated from the remaining instars by having a single dorsolateral line while the latter instars had several longitudinal lines on the head capsule (Fig. 2). Head capsule size increased with each successive molt (Table 2 and Fig. 2)

First instar larvae fed on the lower surface of the leaves leaving a window-like upper epidermal layer. Second instar larval damage was characterized by small shot holes on the leaves. The remaining larval instars consumed larger portions of the leaves. Complete defoliation, except for the midrib, was characteristic feeding damage of the last 2 larval instars.

The 6th instar stadium required 10.27 days, ca. twice the time to develop compared to the other instars (Table 1). This longer stadium resembles other noctuids such as the lawn armyworm, *Spodoptera mauritia acronyctoides* Guenée (Tanada and Beardsley, 1958) and the monkeypod-kiawe caterpillar, *Melipotis indomita* (Walker) (Oda and Maui 1974). Prior to the prepupal stage, the larvae ceased feeding, defecated, and formed their hybernaculum. No fecal pellets were observed within the hybernaculum.

TABLE 1. **Stadia of the various immature stages of** A. indiscriminata (Hampson)

Duration (Days)	Egg	1st Instar	2nd Instar	3rd Instar	4th Instar	5th Instar	6th Instar	Pre-Pupa	Pupa
1									
2									
3			29	6	2				
4	2	5	21	37	26	1		35	
5	95	41	7	13	25	32		22	
6	322	13			4	21			
7	7					2			
8						1			
9							7		
10							28		
11							16		
12							4		
22									1
23									6
24									12
25									19
26									10
27									6
N	426	59	57	56	57	57	56	57	54
Mean Duration (Days)	5.72	5.14	3.16	4.12	4.54	4.47	10.27	4.39	24.91
SD	0.51	0.64	0.70	0.57	0.68	0.68	0.84	0.49	1.22

TABLE 2. *Head capsule width of* A. indiscriminata *(Hampson) larval instars.*

Larval Instar	N	Mean (mm)	SD
I	54	0.59	0.36
II	54	0.98	0.18
III	53	1.55	0.08
IV	57	2.20	0.10
V	57	3.29	0.10
VI	18	4.68	0.39

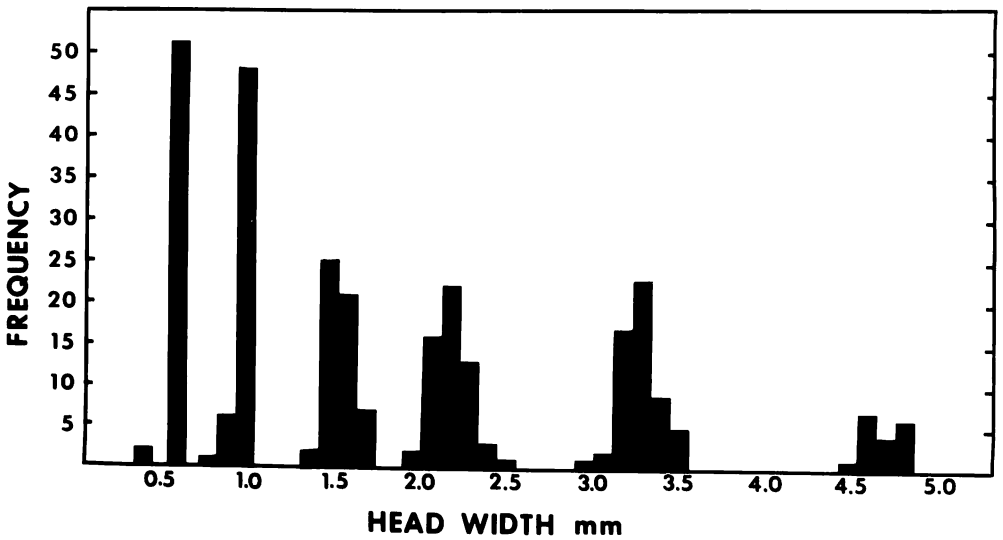

FIGURE 1. Frequency distribution of the head widths of *A. indiscriminata* larvae.

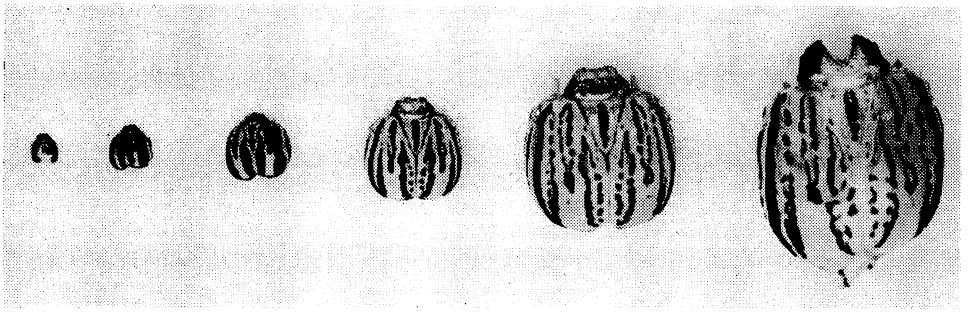

FIGURE 2. Head capsules of the 6 larval instars of *A. indiscriminata.*

PREPUPA

The prepupal stage was designated when the 6th instar larva constructed its hybernaculum. Under laboratory conditions the last instar larvae constructed their hybernaculum by tying guava leaves together. Last instar *A. indiscriminata* larvae observed in the field crawled to the ground to form their hybernaculum with silk and surrounding debris. Late prepupal stage was characterized by lack of movement with the head capsule bent under the thoracic area. The duration of the prepupa stage was 4.39 (0.49 SD) days (n = 57) (Table 1).

PUPA

The pupae had the same general form as other noctuid spp. Sclerotized pupae were dark grey to dark brownish-red, smooth, and hairless. Pupae had a mean length of 3.44 (0.10 SD) cm (n = 30) and a mean width of 0.97 (0.04 SD) cm at the widest region. Mean pupal duration was 24.91 (1.22 SD) days (n = 54) (Table 1).

ADULTS

Adult *A. indiscriminata* was originally described by Hampson (1913). Sexual dimorphism in wing coloration and pattern reported on noctuid adults (Forbes 1954, Tanada and Beardsley 1958, and Oda and Mau 1974) was not apparent in *A. indiscriminata* adults (Fig. 3). Superficially, males were distinguished from females by the long narrow abdomen compared to the short stout abdomen of the female.

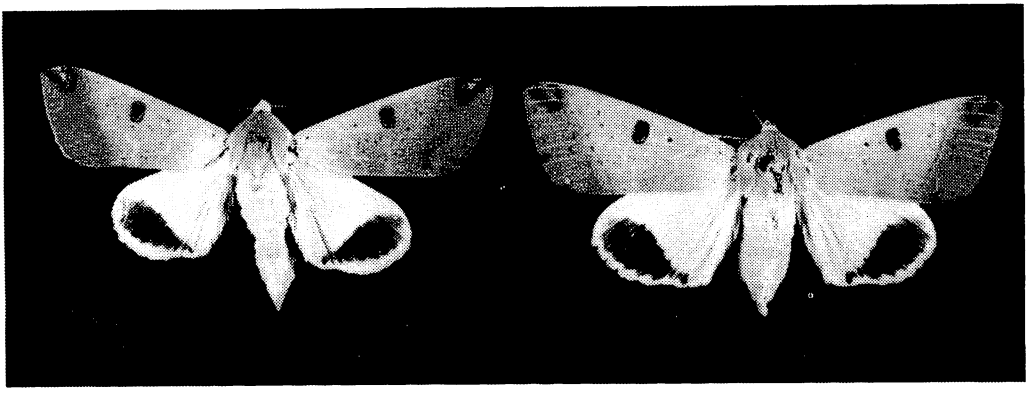

FIGURE 3. *A. indiscriminata* adults, male (left), female (right).

Upon emergence and throughout the longevity study, the adults fed on honey-water solution. Mating was not observed, moreover, eggs deposited were sterile. It appeared the rearing jars were not conducive for mating and oviposition.

The mean preovipositional period was 13.94 (3.05 SD) days (n = 17). Oviposition occurred until the females died. Dissected dead females revealed that they did not deposit all their eggs. The mean longevity of the adult male and female *A. indiscriminata* was 29.62 (7.27 SD) and 30.30 (8.99 SD) days, respectively. The fact that *A. indiscriminata* did not mate in the laboratory may have affected the length of its preovipositional period and the duration of the ovipositional period.

Egg to adult duration was ca. 68.1 days under laboratory conditions. Since there may be up to 5 generations per year, *A. indiscriminata* has the potentials of becoming a major pest. Moreover some of our native and exotic forest plantings may be defoliated by the guava moth since *Eucalyptus* spp and other Myrtaceae are known hosts. Further studies should be conducted to determine if *A. indiscriminata* could develop on Ohia-lehua, *Metrosiderous collina polymorpha* (Guad.) Rock and on the many introduced *Eucalyptus* spp (Nelson 1965) in Hawaii.

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